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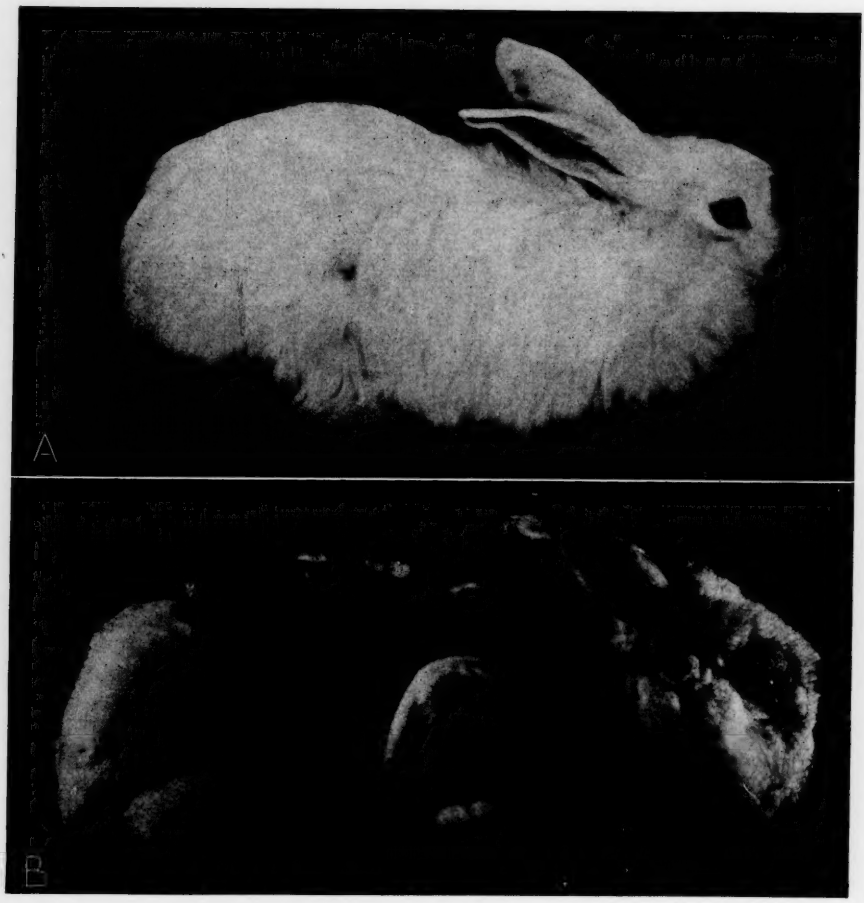

GENOTYPE RECESSIVE: SHAVE DOMINANT

(SEE PAGE 85)

Double Haploid Peppers

Indian Water Buffaloes

VOLUME 36 MARCH, 1945 NUMBER 3

The American Genetic Association

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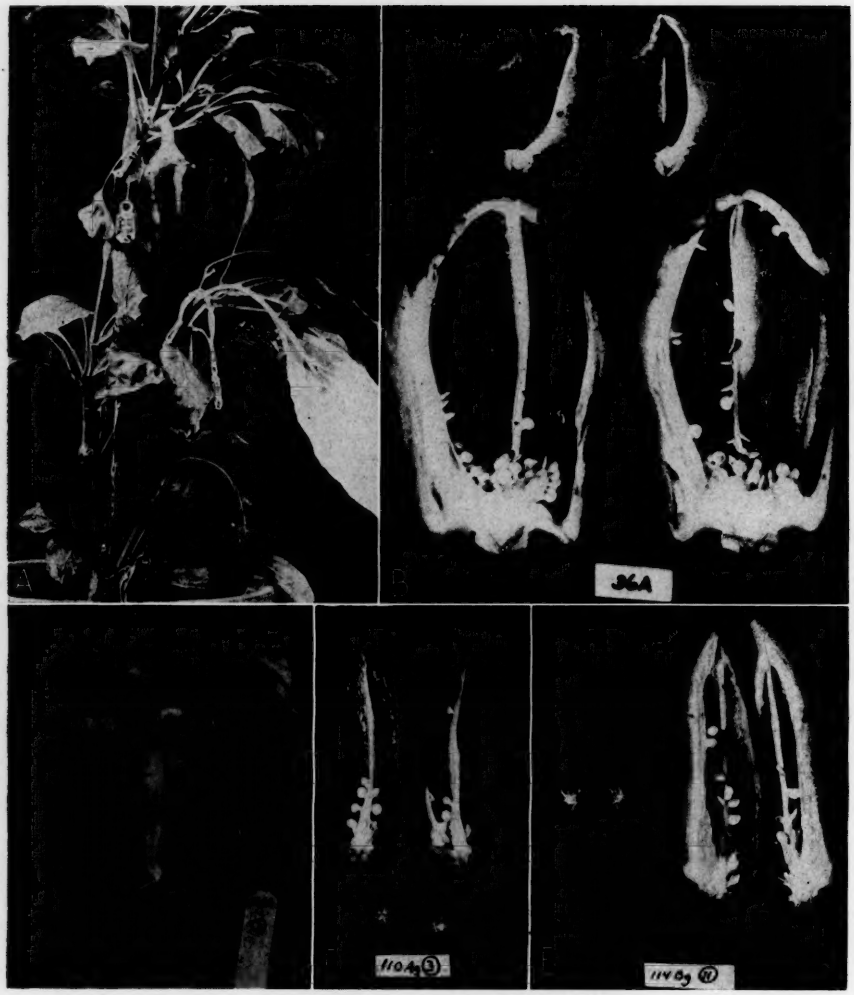


"DOUBLED HAPLOID" PEPPERS

Figure 1

These photographs show the striking changes in fruit size resulting from doubling the chromosome number of haploid pepper plants. *A* shows a diploid fruit produced on a cutting of haploid 36A, after the growing point had been treated with colchicine. *B* shows haploid fruits (above) compared with diploid fruits of a treated cutting of this same plant. *C* shows a comparable fruit on a diploidized cutting of haploid 110A, with sections of haploid (below) and diploid fruits shown at *D*. *E* shows comparable fruits of haploid 114B. The small haploid fruits have only an occasional seed. The derived diploid fruits were relatively highly fertile, and weighed three to five times as much as the haploid fruits.

THE FORMATION OF DIPLOID PLANTS FROM HAPLOID PEPPERS*

MARGUERITE G. TOOLE AND RONALD BAMFORD

IN a previous paper[4] the observations on seven haploids, secured from twin seedlings of *Capsicum annum* L. were reported. At that time the possibility of the use of such plants in producing homozygous diploids was only briefly discussed since it had been so extensively summarized by Kostoff[10] in his review on the subject of haploidy. That he was critical and doubtful about the use of doubled haploids for any commercial purpose is evident when he says of such suggestions (p. 116), "unserious propositions to the plant breeders discredit genetics." His support for such views was based on the impossibility of securing diploids of these haploids by vegetative doubling and he discusses at great length the heterozygous nature of the progeny resulting from haploid seed. He referred to spontaneous doubling and the decapitation method used by others for producing such doubled haploids but criticized these as very limited in their application. The more recent use of colchicine, sanguinarine, and other polyploidizing agents was apparently unknown at the time of writing. The recent reports of the use of colchicine on haploids by Beasley[1] in cotton, and Newcomer[11] in tomato are examples of this possibility. The location of new haploids and the application of colchicine and other successful techniques seems to be all that is necessary to dismiss this objection.

Another of Kostoff's objections[10] is that such doubled forms are not practical in themselves because of their homozygosity. He assumed that it is necessary to use such a doubled haploid in itself but the use of such forms does not necessarily have to be direct. The use of these as test plants for isolating strains of highly heterozygous material, as Silow and Stephens[14] have recently pointed out, is another potentiality. He has also called attention to the many variable types of haploids that any diploid may yield. For example, the number of haploids of variable genetic constitution from any one diploid, particularly a highly heterozygous one, would be very numerous. The high percentage of haploids in recent years observed in twin seedlings would not make it an impossible task to obtain a sizable sample from a promising diploid.

The purpose of this present study is to report on the doubling of these pepper haploids and to examine the fertility and the potential use of such doubled forms as breeding material. Since Boswell[3] has already indicated that peppers are highly heterozygous, and that there is not complete agreement as to the inheritance of certain characters, this study should help in that way and possibly assist in studies such as that by Holmes[9] concerning virus disease resistant strains.

Materials and Methods

The material for this study has previously been reported,[4] except for one plant (104B) which was doubtful at that time. It has now been confirmed as a haploid. The eight haploids were arbitrarily designated by numbers when the material was obtained in 1941. They are as follows:

36A, 40A	World Beater
60B	Long Thick Cayenne
108A	Long Red Cayenne
104B, 110A, 114B	Anaheim Chili
233A	King of North

This table differs from that previously reported in that varietal names have now been assigned to each haploid. This identification has been made possible by the assistance of Robert Wester, Assistant Horticulturist, of the Division of

*Scientific Paper No. A-95. Contribution No. 1954 of the Maryland Agricultural Experiment Station (Department of Botany).

Fruit and Vegetable Crops and Diseases, Soils and Agricultural Engineering, Bureau of Plant Industry, United States Department of Agriculture, Beltsville, Maryland, and checked on the basis of Erwin's study.[6]

Cuttings of rapidly growing stems were made in order to insure rooting, for woody tissue does not seem to form a callus readily at the basal end. The rooted cuttings were potted and grown in the greenhouse until sufficient material was available. When they had four or five branches they were then ready for experimental treatments. Three of the haploids were difficult to propagate by cuttings. This was overcome by grafting these haploid scions on to diploid stock. The variety California Wonder was used exclusively as the stock for the grafts and care was taken to remove any shoots of diploid origin occurring below the graft. All scions remained true to their haploid derivation, upon inspection of pollen and fruit set.

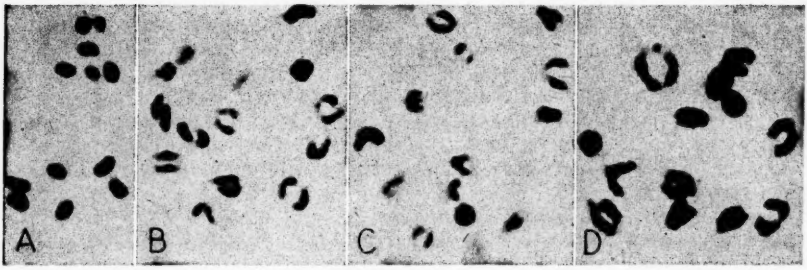
Since haploid plants were being used, the methods of seed treatment with colchicine previously reported[13] for *Capsicum* could not be followed. Colchicine was applied in the form of lanolin emulsion as used by Newcomer[12] on tomato, and formulated by Blakeslee and Avery.[2] Strengths of 1%, .67%, .4%, .18% and .1% colchicine emulsion were smeared on the growing tips either in one or two applications a week apart. In addition to this method of application, ten plants were treated with an aqueous solution of colchicine by means of an internal injector inserted at a node. This consisted of a short piece of glass tubing drawn to a point at one end and filled with colchicine. The pointed end was inserted about ¼ inch into the stem at the node. A total of 266 cuttings and grafts were propagated and of these, 151 were colchicine treated.

Flower buds were fixed in a 3:1 absolute alcohol-acetic acid solution and stored in 85% alcohol. Determination of root tips was early abandoned because of the very small size of the chromosomes. After this treatment the slides were made by the regular smear technique, using propiono-carmine. Epidermal mounts and pollen grains were stained by the same method. Chromosome counts were made from the meiotic divisions of the pollen mother cells of both suspected diploids and their seedlings. Comparison of stomata and cell size was accomplished with the aid of a camera lucida. All magnifications are indicated on the plates.

When the flowers opened they were selfed by hand pollination and a short piece of paper soda straw was then placed over the stigma for 48 hours to prevent chance cross pollination. Since fertilization was found to follow pollination after 42 hours in a greenhouse at 80°F. by Cochran,[7] this was thought to be a long enough period. Covering the flower in this way for a longer period resulted in the dropping of that flower. Maturity of a fruit was judged by the uniform red color, and if seeds were produced, they were removed from the fruit

TABLE II. Results of Colchicine Treatment of Haploid Peppers.

Variety	World Beater	Beater World	Long Red Cayenne	Anaheim Chili	Long Thick Cayenne	Anaheim Chili	Anaheim Chili	King of North
Number	36A	40A	60B	104B	108A	110A	114B	233A
Number of plants	59	59	41	6	32	14	15	40
Number of treated	47	35	17	4	17	3	11	17
Number of doubled haploids	11	7	4	3	5	1	2	3
Number of fruits	16	8	13	5	5	1	3	3
Number of seeds	795	216	341	406	663	26	44	490
Number of seedlings	50	83	8	1	23	15	0	8



CHROMOSOMES OF HAPLOID AND DERIVED DIPLOIDS COMPARED

Figure 2

A—Metaphase I of haploid 104B, showing twelve univalent (unpaired) chromosomes. *B*, *C*, and *D* show diakinesis of "doubled haploids," all with twelve *pairs* of chromosomes. The three preparations are from flower-buds of diploidized haploid 60B; a seedling of diploid 104B, and diploid 36A (see Table II).

and allowed to dry for at least two days before planting. Pictures of fruits were taken just prior to seed removal.

Results and Discussion

The results for each haploid are presented in Table II. This table shows the number of plants treated, the number of successful doubled haploids, and the number of fruits, seeds and seedlings which have resulted up to the time of writing.

Chromosome doubling was effected in thirty-six out of the 151 plants that were colchicine treated. A check of the cell, stomata, flower, and fruit sizes was made for each diploid and this was verified by chromosome counts at meiosis I of the pollen mother cells. No marked variation was observed in leaf size between haploid and diploid plants. In general, the stomata were larger in the diploid plants but in a few cases no noticeable difference could be seen, although the problem of getting comparable leaves was a difficult one. The flowers were consistently larger in the treated plants and showed an abundance of pollen. All fruits from diploid tissue were two to five times as large as the haploid fruit. The yield of seeds from induced diploids varied from one seed to three hundred

Thirty-five of the diploids were obtained by means of treatment with colchicine-lanoline emulsion. One diploid shoot developed at a node where an internal injector, containing a .1% aqueous solution of colchicine, was placed. In both treatments all the treated area suffered severely but eventually adventitious shoots appeared and these provided the diploid material. Cessation of growth varied from a period of two to six months.

Meiosis in all the doubled haploids was observed and found to be regular. Twelve bivalents were observed at diakinesis later resulting in normal tetrad formation and producing apparently fertile pollen (Figure 2*B*, *D*).

Seeds of each doubled haploid have been obtained and the subsequent seedlings of all but 114B and 233A, which have just been harvested, are flowering. Meiosis has been observed in approximately 20 of the diploid seedlings from six of the types and the microspores have been examined in 20 more. Meiotic divisions are regular (Figure 2*C*), and the pollen grains were apparently normal. No fruits have been allowed to set up to the time of writing.

The results of these observations on the production of doubled haploids in *Capsicum* agree with Beasley,[1] and Silow and Stephens[14] in cotton and Newcomer[12] in tomato in that a high percentage of diploids can be obtained through the use of colchicine. In *Capsicum* it was possi-

ble to double all eight haploids and nearly 25% of all the plants treated yielded diploid branches. Kostoff's objection, concerning the difficulty of producing diploid material, does not appear to be well founded in the light of the wide-spread use of colchicine and other agents at the present time.

The regularity with which meiosis proceeds in *Capsicum* diploids, the resultant good pollen and apparently normal fruit formation, all indicate good fertility which is a result of complete duplication of the haploid set. The variable behavior of the chromosomes observed in the haploids was not seen in the derived diploids. This agrees with Newcomer[12] who reported the two diploid tomato plants produced showed normal meiotic behavior. It must be pointed out that this would not be true where continued pollination of a haploid plant might result in the formation of diploid seeds, a method advocated by Harland[7] but criticized by Kostoff[10] and others. Webber[15] has reported such irregularities in meiosis in diploids grown from seeds produced by haploid tobacco plants. On the other hand, similar irregular behavior was reported long ago by Hollingshead[8] in a spontaneous diploid shoot of *Crepis* where the lack of pairing of presumably homologous chromosomes occurred at metaphase of meiosis I. It appears then that normal meiosis would not always result from diploid shoots and this would be particularly true in colchicine treated material where aneuploids and myxoploids frequently are reported.

The use of doubled haploids to take advantage of their supposed homozygous composition has been criticized and supported by various workers. In many cases both types of comment have been offered by the same worker. Perhaps this is because of the lack of successful experimental results; at least, they are not recorded in the literature. Until these forms can be compared with standard varieties, hybridized with the same types, tested for homozygosity, and hybridized among themselves, any further discussion would be theoretical.

Summary

By the use of colchicine, eight haploid peppers were successfully doubled to the diploid form. Approximately 25 per cent of the treated plants yielded diploid shoots. Meiosis in these diploids is normal and all have produced fruits from which seeds were obtained. Plants from all but one of the types have been grown; and meiosis and pollen formation is regular in all the progeny of the initially doubled plants.

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THE WATER BUFFALO OF INDIA

RALPH W. PHILLIPS*
United States Department of Agriculture

CATTLE and water buffalo are the most important animals in Indian agriculture. They are the chief sources of milk and draft power and provide some meat for the portion of the population that eats it. However, the position of the two species is somewhat different. Cattle are used primarily for work, on farms and in highway transportation; milk production is a minor function, except in a few breeds such as the Sahiwal and Red Sindhi. Milk production is the chief function of the water buffalo in India. Some buffaloes are used for draft purposes but they are considered too slow, when compared with longer-legged, fast moving bullocks of the draft breeds of cattle. They are less able to withstand extreme heat unless they have frequent access to a pond of water or have water poured over them for cooling.

The Indian breeds of cattle were described by the author[4] in an earlier paper. Some of these breeds have been used in North and South America, particularly in the tropical and sub-tropical areas, but the water buffalo has not been used to any marked extent in this hemisphere. Their successful use for production of work, milk and meat in Trinidad is reported.[1] The ability of the water buffalo to withstand tropical conditions, to utilize a large amount of coarse roughage and to produce a fair amount of milk with a high fat content, makes it an animal worthy of consideration for use in some of the tropical and sub-tropical areas of the western hemisphere. Experimental work is needed to determine the extent to which it can be used successfully in these areas. This paper has been prepared to present a brief description of the breeds of water buffalo that are generally recognized in India. The approximate locations of the native homes of the various breeds are indicated on the map in Figure 3 and photographs are presented in Figures 4 and 5.

Description of Breeds

Murrah

This breed is native to the southern Punjab and Delhi province, and is sometimes called the Delhi breed. It is typical of a wide range of deep, massive buffaloes which, with small variations, are bred for milk production in the north of India, particularly in the Punjab and Sind. Murrah buffaloes have been introduced in many other parts of India to improve the local stock. These animals have massive, deep bodies and short, heavy legs. Smith[5] states that full-grown bulls weigh from 1,000 to 1,800 pounds and cows from 800 to 1,600 pounds, and that exceptional animals weigh as much as 2,000 pounds. The head is relatively small and the horns are short and tightly curled. It is this characteristic from which this breed takes its name, *Murrah,* which means curled. The hips are broad, the rump is sloping and the tail is short. The usual color is black, although a fawn-gray color is not uncommon, and white markings are frequently seen on the face, legs or tail. Wall eyes are not unusual.

The Imperial Council of Agricultural Research[2] has published 705 records of Murrah buffaloes bred at recognized farms. Production averaged 4,048 pounds of milk per lactation period that averaged 281 days. Records of 1,609 lactations in purchased animals averaged 3,879 pounds in 269 days. Distributions of these records are as follows:

*The author is Senior Animal Husbandman, in charge of Genetics Investigations in the Bureau of Animal Industry, U. S. Dept. of Agriculture, Beltsville, Md. The information upon which this paper is based was assembled while on a special mission in India and China in 1943 and 1944 for the Division of Cultural Cooperation of the U. S. Department of State.

DISTRIBUTION OF WATER BUFFALO BREEDS IN INDIA

Figure 3

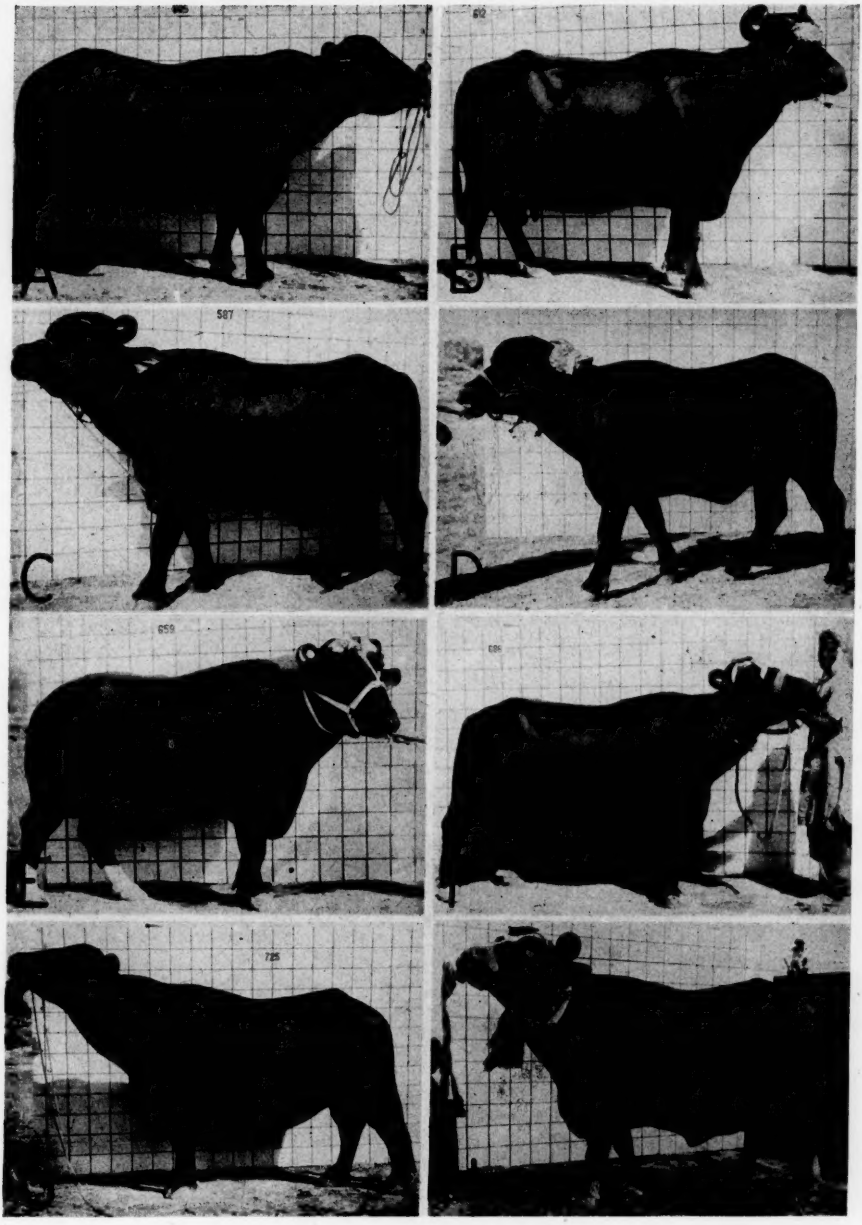
Lactation yield	*Home-bred*		*Purchased*	
	No.	*Percent*	*No.*	*Percent*
2,000-3,000	125	17.7	295	18.3
3,000-4,000	231	32.8	661	41.1
4,000-5,000	213	30.2	468	29.1
5,000-6,000	96	13.6	136	8.5
6,000-7,000	27	3.8	30	1.9
7,000-8,000	11	1.6	15	.9
8,000-9,000	1	.14	4	.2
9,000-10,000	1	.14	—	—
-	705	99.98	1609	100.0

Kundhi

This breed is found in the forest tracts along the Indus River and in the rice-growing regions in northern Sind. It closely resembles the Murrah breed, from which it appears to be an offshoot. The animals of this breed are rather large, and according to Ware[6] weigh 1,000 to 1,200 pounds. The usual color is jet black, but light brown animals are also found. The forehead is slightly prominent and the face somewhat dished. The horns are thick at the base, and incline backward and upward, ending in a moderately tight coil, thus resembling a fishhook (*kundhi*) from which the breed takes its name.

Nili

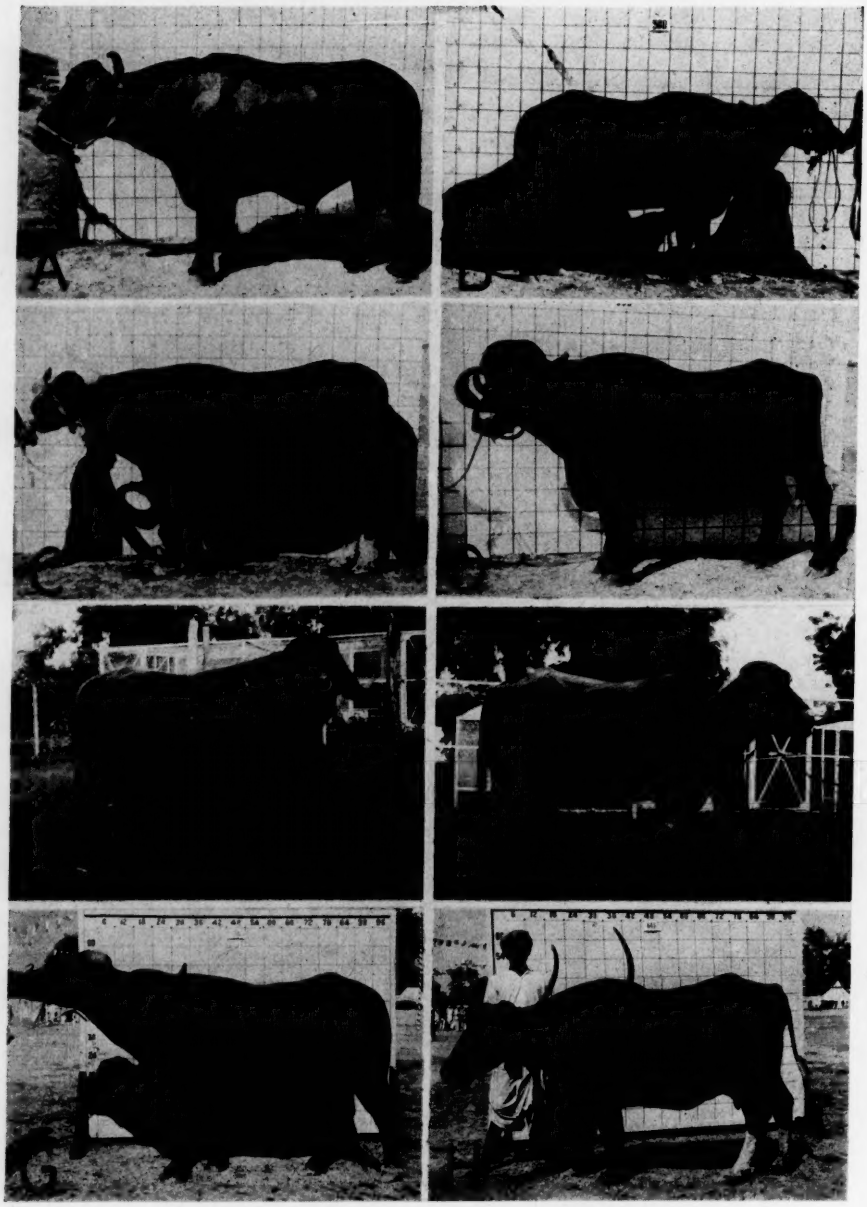
These animals are found in the valley of the Sutlej River, particularly in the Montgomery and Ferozepore districts of the Punjab. The breed derives its name from the supposedly blue (*nili*) waters of the Sutlej River. The body is of medium size, the head is somewhat elon-



BREEDS OF WATER BUFFALO

Figure 4

The water buffalo is chiefly used for milk production in India, though in other tropical countries it is also valued as a draft animal, mainly in working wet lands, like rice-fields. Bulls (left column) and cows (right column) of four breeds are shown here: *A-B*, Murrah; *C-D*, Kundhi; *E-F*, Nili; *G-H*, Ravi.



"SHORT-HORN" AND "LONG-HORN" BREEDS

Figure 5

Bulls (left) and cows (right) of four Indian breeds of Water Buffalo. *A-B*, Mehsana; *C-D*, Jaffarabadi; *E-F*, Surti; *G-H*, Nagpur.

gated and somewhat bulging at the top and depressed between the eyes. Ware[6] states that mature males and females weigh an average of 1,300 and 1,000 pounds respectively. The neck is rather long and thin. The horns are small with very tight coils. The tail is rather long. The usual color is black but brown is also seen. White markings on the forehead, face, muzzle and legs and a white switch on the tail are much liked, and wall eyes are also desired by the native breeders. This breed is also very similar to the Murrah.

The Imperial Council of Agricultural Research[2] has published records on two purchased Nili buffaloes that averaged 5,959 pounds of milk in 361 days.

Ravi

These animals are found in the valley of the Ravi River, and particularly in the Sandal Bar. They are sometimes referred to as Sandal Bar buffalo. The forehead is flat, the nasal bone is broad and there is marked depth from the base of the horns to the angle of the jaw. There is a distinct "double chin." The horns are broad and thick, with a tight coil. The neck is rather long and thick. The usual color is black, though brown is not uncommon. Wall eyes and white markings are liked. Pink markings sometimes occur on the udder and brisket. This breed is also very similar to the Murrah.

Mehsana

This breed is found in Baroda State and neighboring areas. It appears to have been derived from a mixture of Murrah and Surti blood and Murrah bulls are still commonly used for grading up. In general appearance the animals are intermediate to the Surti and Murrah breeds. The color is black or fawn-grey, usually with some white markings on the face, legs or tip of the tail, but there is no fixed color. Compared with the Murrah, the body is somewhat longer, the legs are longer and lighter, the head is rather heavy, and the horns are longer and not so tightly curled.

Jaffarabadi

This breed is found in its purest form in the Gir forest of Kathiawar. They are large and require large quantities of fodder but the milk yield and the butterfat percentage are both said to be high. The color is usually black. When compared with the Murrah, the body is longer and not so compact, and the head and neck are more massive. The forehead is very prominent. The horns are heavy and inclined to droop on each side of the neck, and then turn up at the points but not in such a tight curl as those of the Murrah.

Surti

This breed is found in the Gujarat area in Bombay province and the neighboring territory of Baroda State. It is also found in some other parts of southern India. The animals are compact and of medium size. The head is long and broad and rounded between the horns. The horns are flat and are long and sickle-shaped. The color is black or brown. Some specimens have white markings on the jaw, brisket and switch of the tail.

Nagpur (Ellichpur)

This type of buffalo is found in central and southern India. It is quite distinct from the Murrah and according to Olver[3] represents an ancient indigenous type. The body is generally lighter and the legs finer and longer than those of the buffalo of northern India. The neck is comparatively long and the face is long and thin, with a straight profile. The horns are long and flat, and pass back on either side of the neck with only a slight curl. They are used for milk and to some extent for work, but milk production is reported by Olver[3] to be lower than that of the Murrah and similar breeds. The usual color is black, but white patches on the face, legs, and tip of the tail are not uncommon.

Discussion

Some similarities between the Murrah and the Kundhi, Nili, Ravi, and Mehsana breeds have been pointed out. Careful study should be made of the confor-

mation and other characteristics, and of the origin of the various groups to determine if there is justification for the separate classifications. The Jaffarabadi also resemble the Murrah somewhat, but may be sufficiently distinct to justify a separate breed classification. The Nagpur is quite distinct from the Murrah and similar breeds. The Surti appears to be intermediate to the Nagpur and the Northern Indian types in horn formation and general conformation. Owing to its characteristics and to the location of its native home, it is possible that it originated from crosses between the Nagpur and the Jaffarabadi or some other of the northern breeds. Careful study would be needed to determine this point.

The water buffalo appears ugly and ungainly to those not accustomed to it. There are some disadvantages to its use, when compared with cattle, notably the need for water in which to bathe or with which it can be sprinkled, in order to maintain normal body temperature during hot weather. Also the milk is quite white, apparently owing to the lack of carotene, but the fat content is usually higher than in cattle, averaging about 7.5 per cent. The water buffalo is also well adapted to working in rice fields and other wet areas, such as those of eastern India and southern China. It can utilize a considerable amount of coarse roughage of the type usually found in the wetter tropical regions. It is also used extensively in the hot, dry regions of northwestern India, Irak, and similar areas. It gives a reasonable quantity of milk under tropical conditions and is worthy of consideration in areas of this type where it is not already being used. Preliminary tests should be made to determine its adaptability before undertaking large-scale developments.

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The Helen Putnam Fellowship

CAMBRIDGE, MASS., Feb. 11, 1945.—Radcliffe College is offering for the academic year 1945-46 the Helen Putnam Fellowship for Advanced Research in the field of genetics or of mental health.

The fellowship, which carries a stipend of $1,900, will be awarded annually, beginning with October 1, 1945, for an eleven-month period, with the possibility of a renewal for a similar period. Appointments will be limited to mature women scholars who have gained their doctorate or possess similar qualifications and who have research in progress. All normal laboratory facilities will be provided to the holder of the fellowship.

Applications for the award must be submitted to Radcliffe College not later than April 15 and the first holder of the fellowship will be announced about the middle of May. The fellowship will be offered annually, unless the Committee decides to renew for a second year a grant to a fellow.

The Committee on Award includes: President W. K. Jordan of Radcliffe and the following members of the Harvard University Faculty: Arlie V. Bock, M.D., Professor of Hygiene; Stanley Cobb, M.D., Professor of Neuropathology and Psychiatrist-in-Chief at the Massachusetts General Hospital; Alden B. Dawson and Leigh Hoadley, Professors of Zoology; Karl Sax, Professor of Botany; and Edwin B. Wilson, Professor of Vital Statistics.

DOES XX=XY?

A Review of Sex Differences

IF the human race had contrived to be reproduced by parthenogenesis like some of our humbler aphid cousins, many things would have been simpler. But through the action of the genes, or through the reactions to some early surgery (if we follow the story in Genesis) we failed to achieve that vast simplification. Men and women aren't alike, though some zealots have gone even to such lengths as extirpation of the breasts to prove that they are.

The logomachy of sex is vast and confusing. Since the truth about men and women is basic in the development of that good life which planners, statesmen and legislators are so hopefully verbalizing toward, Amram Scheinfield has performed a most valuable service in wading through this morass of words—an epistemological Jack Horner busily looking for factual sugarplums. He expected to take two years to extract the more important ones, squeeze the water of opinion out of them, and bake a tasty verbal cake of the *real* "facts of life." It turned out that nearly six years (and the cooperation of a distinguished panel of advisors) were needed to complete the job, recently come to publication.*

At the level of cell mechanics, as well as of anatomy, it has always been nonsense to pretend that men are women or vice versa. The human being has 24 pairs of chromosomes. Twenty-three of these are neutral as concerns normal sex determination. Genetically this can be a big difference. The author does not make the point that there is more than one instance in the genetic literature where one allele conditions the development of an array of characteristics so different from the normal that individuals otherwise of identical heredity might be classified as members of separate species. Hence this basic dichotomy, involving a whole block of genes and extending to every cell in the bodies of all men and women, justifies us in accepting the evidence of our eyes and of "the record" that the two sexes neither look nor act alike.

If it seems silly to labor so obvious a point, Scheinfeld reminds us that some sex-equality cultists go even so far as to deny that there are any primary differences. If a visit to a bathing beach seems to belie this view, we are told that the disparities easily observable without a telescope at a couple of hundred yards are due to "conditioning" incidental to the different bringing up of boys and girls. Apparently these people "never stopped to compare a cow and a bull, a tabby and a tomcat, a hen and a rooster, or the female and male of almost any species, and to ask whether their differences were also due to the lack of equal rights." At the other end of the spectrum of *ad hoc* assumptions stand the equally earnest proponents of the view that regardless of cultural differentials, women are "inherently inferior to men." Some zealots of this school have gone to the length of insisting that the two sexes actually are different species, with women cast in the unenviable role of necessary parasites! The waters of objective and usefu! thinking have further been muddied by theologians bent on labelling sex "beastial" or "unclean," and by biologists who have ignored the social factors. Practically every possible combination of fantastic nonsense has been solemnly and authoritatively adumbrated. This often hysterical discussion has engendered much smoky heat but very little light.

Scheinfeld's attempt to clarify the situation considers the early developmental history of the two sexes after the basic pattern has been determined at fertilization. Even before birth, definite differences in behavior can be demonstrated.

*WOMEN AND MEN, by AMRAN SCHEINFELD. Pp. xx + 453. Illustrated with drawings by the author. $3.50. Harcourt Brace & Co., New York. 1944.

Males begin giving the lie to the myth of the mighty he-man very early in their prenatal history by showing a much higher fetal mortality than females. At the eighth week, when it begins to be possible to tell male from female, the male death rate is about three times that of the female. This high mortality decreases rapidly, but the proportion of males failing to cross the birth-bridge is considerably higher than females. Throughout life this differentiation between the sexes is clearly demonstrated; and the better the conditions under which a population lives, the more marked is the advantage of that traditionally "weaker" female sex.

Different in Body and in Mind

There is a fascinating chapter on the differences in development and in pattern of activities displayed by boy babies and girl babies, and the comparison of their behavior with infant chimpanzees. The idea that little girls like to play with dolls because they are taught to, and that little boys go in for more destructive activities for the same reason, just does not hold up. These basic outlooks on life seem to reflect fundamental differences in the way male and female cells are physio-chemically structured.

The chapter on the psychological similarities and differences also has much meat in it. Shortly after World War I a tremendous hullabaloo arose because the Army Alpha test "proved" that the mental level of the population of the United States averaged that of a twelve year old child. The oratory looked very foolish when it turned out that the psychologists had standardized this test so that the average would represent twelve-year-old mentality. It will astonish many who have not closely followed the interesting game of mental test construction to learn that a similar surpassing Brodie enters into the attempts to prove via standard psychological tests that men and women do not differ in the way their minds work. In constructing such tests, a major headache has been to find problems and puzzles showing no sex difference. To this end, wherever possible, all test materials showing a sex difference have been discarded. So all-pervasive are sex-differences that it has been impossible to find enough sex-neutral test-material. Hence it has been necessary to balance sections of tests which males find more than averagely difficult, with other female-stumping sections. This gives *total scores* for males and for females at just about the same level, even though the two sexes travel by quite different paths to achieve them. Hence instead of "proving" the essential similarities of the male and female think-box, the whole process of constructing psychological tests is actually good evidence that men and women very definitely tend to think and behave differently in test situations. As this reviewer has pointed out more than once before, the freighting of these differences with value connotations, "superior" or "inferior," or "good" or "bad," is purely arbitrary. The important fact is that males and females are different, and there is no reason whatever to be alarmed or upset by this fact; quite the reverse. *"Vive la difference!"*

They Die Differently

The record of reaction to diseases is equally striking. Since males have only one *X*-chromosome, pathological genes are not "shielded" by normal alleles on its homologue. This makes sex-linked diseases such as color-blindness and hemophilia virtually a monopoly of the male sex. Diabetes is the only important hereditary physical disease in which females are more frequently affected than males, though they are more susceptible to mental disease than men. Again, the differences appear to be something that is built into the individual at the start, not wholly the result of exposure to varied conditions incident to growing up.

Scheinfeld underlines the fact that improvements of the environment have consistently enhanced the differences in chances of survival for men and women. Time and again the better adapted females have gained more through improved conditions than have males.

This leads to a very important situa-

tion for our population as a whole. Up to the present, the excess of males at birth and a large male immigration have tended to maintain a parity of the sexes in spite of relative male inviability. The time has definitely arrived when this is no longer true, and the present war will intensify the scarcity of males. Furthermore, women tend to mature at a younger age than men, and tend to marry men somewhat older than themselves, thus intensifying the relative scarcity of marriageable males. This means that millions of women will never marry, a distressing fact with very important eugenic implications.

The central portion of the book is given over to the cataloging of the differences between men and women. The sexes differ in the distribution of tissue and tone of muscles, and obviously enough in body contours. Considerable differences have been demonstrated between brains of male and female laboratory rats, and parallel differences have been found in analyses of human brains. The female brain is measurably richer in cephalin and phosphorus. The male brain assays higher in lecithlin and in other compounds. The significance of these differences in terms of the mental efficiency of the two kinds of brains is wholly unknown. Both sexes have many, probably all, of the hormones designated "male" and "female"; sex-differences are in concentration rather than in kind. Men have a higher concentration of red blood cells than women do, and women have more white blood cells than men. Metabolically, women are better temperature-regulated than men, both with respect to heat and cold. Men respond better to prolonged physical exertion and have a larger food intake. Men and women die of different causes. The ten outstanding male-killers and the four leading female-killers in the U. S. in 1940 were as follows:

Male Killers	*Male*	*Female*	% Excess ♂
Diseases of the heart (all forms)	205,466	146,297	39
Diseases of coronary arteries, angina pectoris	67,931	28,916	132
Tuberculosis (all forms)	26,598	16,613	57
Syphilis	8,768	2,933	194
Ulcers (stomach or upper intestine)	6,745	1,340	391
Cirrhosis of the liver	7,101	3,409	105
Motor vehicle accidents	24,063	7,241	229
Homicide	2,927	796	250
Suicide	13,990	4,294	222
Alcoholism	1,917	264	700

Female Killers	*Male*	*Female*	% Excess ♀
Cancer (all forms together)	71,109	76,674	9
Diabetes mellitus	12,438	20,168	64
Gallstones	2,551	4,993	98
Exophthalmic goiter	574	2,830	380

The crime spectrum of the two sexes differs notably. For a one-year period in the United States (1943) convictions for serious offenses totalled 60,083 males and 2,609 females. Truly this is an amazing difference, and if we attribute most of it to the greater aggressiveness of males, they appear to pay handsomely for sticking their necks out. Part of this is due to different social attitudes with regard to the two sexes. Our author reminds us that a man will be arrested for appearing in public in female attire. A woman, as we know, can wear pants (at home and on the street) with impunity. There is also a popular belief that a beautiful woman can get away with murder, literally. The reviewer might note a remarkable sex difference which the author omits. A pistol is notoriously a very difficult weapon to hit anything with. Nevertheless, a perusal of the daily papers indicates that any woman can hit any man, bingo, with one of these unreliable gadgets, from the hip or the handbag. This might account for most of the difference in homicide death rates; the men try, perhaps, to return the compliment, but just miss more often.

Two Kinds of Jobs

Curiously enough, the achievement-genius pattern follows in a remarkable way that of criminality. There are many gifted women, but in the arts and professions, Scheinfeld finds a dearth of female geniuses. Lack of opportunity is

undoubtedly a large factor, but in music and the arts especially, this is not the whole explanation. Different outlooks rather than differences in ability are very important:

As individuals, the achievements of women compared with those of men can never be quite the same qualitatively — in character, form, manner, or type of expression — in any creative field where sex differences in personality, temperament, experiences, or objectives would influence the results. So long, then, that the same precise standards cannot be applied to the achievements of both sexes, or that exactly the same environments can never be provided for both, it is highly doubtful whether we ever can judge their works in terms of relative inferiority or superiority.

Thus, the questions of how much of women's relative lack of achievement in the arts, sciences, or professions is due to something inherent in their natures or to something inherent in their environment will probably never be answered satisfactorily.

There is a most interesting chapter on division of labor. In terms of speed and endurance, the mammalian female has very tough going. There are nearly two seconds difference between the world record for the 100-yard dash for men and women. This same situation exists among Thoroughbred horses where there is a considerable weight handicap in favor of the female. The only female to win the Kentucky Derby had a five-pound handicap. Whirlaway, carrying 13 pounds more, ran the same race in four seconds less in 1941. The economic division of labor ranges from 100 per cent for males in battle, to 91 per cent females engaged in cooking. The supremacy of males in war and heavy industry is striking.

The Russian experiment in complete equalization of the sexes is dealt with in a separate chapter. The principles of specialization established by racial trial and error seem to have been too potent even for the powerful magic of dialectic materialism. At any rate, Scheinfeld documents in considerable detail the changing attitudes toward all-out "sex equality" as expounded in the early years of the Soviet Revolution. While there have been remarkable and most heartening increases in female participation in technology, in medicine, and in a host of other activities, this has not extended to the heavy industries or to war. The trimly-dressed machine-gun-packing Amazon, Pavlichenko, who toured the United States proudly displaying 309 notches on her tommy-gun is only the exception that proves the rule. In certain situations the basic differences in the psychology and physiology of men and women is a central fact that cannot be ignored.

And So What?

In his closing chapter the author attempts to present a general statement of how the relations of men and women look to him, and what of the future? This leaves the reviewer somewhat perplexed. Several years ago Pearl Buck attempted a somewhat similar philosophical statement about the interdependencies of the two sexes in some freer and less obsessed society than ours happens to be. She pictured women as having such huge reserves of unexpended energy that they were literally likely to blow human culture to pieces for lack of something to do. Scheinfeld's marshalling of evidence that the drive of women is not as intense as that of men may reassure those who have been listening for the explosion of Miss Buck's "gunpowder woman." He becomes completely and lyrically starry-eyed about the great all-embracing sisterhood of women everywhere, the like of which he believes does not exist among males:

By nature and training women are singularly well equipped to lead the world toward peace. They begin with a bond of human kinship among themselves which men never can know. Where the "brotherhood of man" is as yet only a figure of speech, the "sisterhood of women" always has been a fact. When one woman sees another with life growing within her, or with an infant at her breast or a sick child in her arms, it matters not if one is a queen and the other a charwoman, if one is white and the other black, one Gentile and the other Jew, Mohammedan, or Hindu, they understand each other, their feelings, thoughts, fears, and hopes. Is it too much to say that through this creating and nurturing of life instead of death, through this simple common understanding which transcends all boundaries of race, nation, class or creed, and which already exists among their own half of the

world's population, women offer us the speediest route toward peace and good will among all peoples?

Their biological functions just don't seem to be that fundamentally important to many women. When Scheinfeld sees this great biologically knitted sorority furnishing the driving power that will unite all peoples and races in a great world-wide sisterhood (and eventually brotherhood—he hopes) there are those who will suspect our author has let generalized romance get the better of him. That a rather hard-boiled guy who has been around should ask us to get all het-up on such a very questionable premise is perhaps just one more proof that this problem of the *X* and *Y* chromosomes is well nigh impossible to do logic by. Certainly this attitude is not in keeping with the factual and realistic approach of the rest of the book. In honest realism the reviewer is convinced, lies the hope of the future. We must have an acceptance of differences without labelling them "good" or "bad," "superior" or "inferior," and a realization that these differences are essential to a diverse and rounded culture. The Troubadors tried that "angel" line a long time ago, and it did not work too well. Let's get ahead and not go back to that. As the reviewer has said before—and he says it again—"women's people." Different, sure: and queer, sure (as men are, God wot!); but people nevertheless—not angels and assaying no higher in paracites than men. That is an excellent launching platform to take off from toward Utopia.

—ROBERT COOK.

A NEW SEX-LINKED DEFECT IN CATTLE

A NEW case of sex-linked heredity that is believed not to have been recorded heretofore in the literature has appeared in a herd of registered Herefords owned by Calvin Olsen, at Vernon, Tooele County, Utah.

The characteristic occurs as a defect of the front feet, appearing in males but not in females. Affected males have an extra toe on each front foot.

When the calves are born they are able to function quite normally, but as they gain in weight, their feet first become tender and then lame. By the time they weigh from 400 to 500 pounds one can outrun them on foot and even catch them on the range, and when their weight reaches 600 to 800 pounds they become tender and lame. Hence it can be considered as sub-lethal in its effects.

The history of this defect dates back to about six years ago when several pure-bred Herefords were purchased from a Wyoming ranch. One of these cows had a heifer calf which appeared perfect in every way. When next bred this cow was mated to one of Olsen's registered sires and this time gave birth to a bull calf with the foot defect above described. Since this cow's first calf was normal (being a heifer) Olsen reasoned that the heredity of the cow was sound but that the sire of the second calf must carry the defect manifested in the crippled calf. Acting upon this actually erroneous conclusion he disposed of the bull and mated the cow and also her heifer to a bull obtained from the state agricultural college. This resulted in the original cow having a normal female calf while her daughter gave birth to a male calf exhibiting the typical defect.

Even though only a few calves are involved, the evidence is conclusive that the defect was carried by the female purchased from Wyoming and not by the sire that had been disposed of. Sex-linked defects are rare enough so that the owner might have overlooked this possibility even had he been thinking in terms of genetics. (Even had the defect been an autosomal recessive he would have been in error in considering the

cow not to have been involved in transmitting the defect.) Since this time the original cow has given birth to another bull calf showing the same foot defect.

In summary, it appears that all of the male calves produced by this cow and her daughters have shown the foot defect, and that all their heifer calves have been normal. The normal condition of the foot appears to be dominant in the females and recessive in the males. This is the typical pattern of inheritance of a sex-linked recessive character. The same law seems to apply here as with colorblindness and hemophelia in human beings, where the daughter of an affected male is a carrier of the defect she does not herself manifest. Half her sons on the average manifest the defect. The excess of affected males in this case can be attributed to chance, the number involved being very small.

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Temperament Gene in The Thoroughbred

THE question of genetically conditioned temperamental qualities is a perplexing one. That such exist has long been recognized. A genetic analysis of a temperamental difference has perhaps most completely been achieved in the rat by Keeler (*Journal of Heredity*, November, 1942). Wildness in that species was either very closely linked to the agouti gene, or was a pleiotropic manifestation of that gene itself. The problem of domestication of the albino rat thus became simplified to a problem of selecting those albinos which carried the black allele or some other "tame" allele of the agouti gene.

A suggestion that color factors may influence temperament in the thoroughbred is found in an article on "Disposition in Thoroughbred Blood Lines" by Major George C. Saunders (*The Chronicle*, Middleburg, Va., October 27, 1944). Major Saunders went through the nine charts in Wall's *Thoroughbred Blood Lines* and marked all of the sires regarding whom he could get records of disposition. The various lines show striking differences in proportions of bad dispositions. Chart I was devoted to the early history of the breed and was not considered. In the Matchem line (Chart II), information was obtained on 23 sires: Of these 19 were bad and four were good. In Charts III and IV the ratio was 17 good and three bad. Chart V was established by a "violent tempered brute," St. Simon. Nevertheless, only six are bad tempered and twelve are good among those of whom information could be obtained. Chart VIII shows nineteen good and five bad. Approximately the same ratio were found in Charts VIII and IX.

These ratios are not further analyzed in the article so it is not possible to form an opinion as to whether good tempered and bad tempered sublines were evolving in some of these main "families." Major Saunders notes that several bad tempered horses trace back to the Matchem and to the Meddler lines (Charts II and VIII). The possibility that there is a linkage between coat-color factors and temperament is contained in the following statement: "The great popularity of grey horses is apparently well-justified, but I am inclined to wonder if it is the color which made reputation. Is it not possible that the coat is but the trade mark of a line which transmits good sense and steady conformation?" It might also be that the coat color is more than a trade mark; it may actually be an additional end-product of the same gene which is responsible for the desirable temperamental qualities, if not of the conformation. And we know that size and conformation, as well as gland- and brain-weight may be modified by single coat color genes.—R. C.

ONCOLOGISTS' MANIFESTO

SCIENCE advances by alternate compartmentalization and generalization. First you get your raw facts. Then you figure out a conceptual scheme that puts them together into an integrated picture. When the right hypothesis is hit on, a goodly pile of disorganized orts and fragments fit together to make a meaningful and inter-related whole where before there was only confusion. It is perhaps prophetic that in the lobby of the Belmont Hotel at Bar Harbor, Maine, there was late in September, 1944, one table devoted to a large jig-saw puzzle. At one time or another, most of the members of the Conference on Parental Influences in the Causation of Cancer took a hand at trying to fill the gaps in this obstinately refractory puzzle. Like sailors spending their shore leave in a rowboat, this relaxation was actually the same kind of work at a different level as that which engaged their interest during the eight absorbing sessions of the Conference. The purpose of this meeting was to enable specialists in each of the broad and sometimes not very closely related fields of cancer research to place their diverse and sometimes conflicting facts and interpretations in one pile and try to fit all of these odd pieces into a meaningful and coordinated picture.

It was a unique meeting. About half a hundred specialists in fields as far apart as clinical pathology and public relations, statistics, genetics, surgery, immunology, and virusology, took five days to get acquainted and to discuss informally their slants on the cancer problem. It sounds confusing, and sometimes it was. On the fifth day of the Conference, hard-working committees appointed to coordinate the discussions of the various sessions, produced a series of recommendations which may well represent a turning point in the history of cancer research—a point of departure calculated to encourage cooperative studies in what have heretofore too often been completely separated fields. It may mark the beginning of a more effectively coordinated and highly coöperative attack on the problem of cancer. Through the fostering of mutual understanding, it can do much to prevent the setting up of futile and inadequate or of poorly planned investigations. Underlining the need for standardization of definitions in this field, and for such minimal requirements for diagnostic procedure in determining what is cancer and what is not, may do much to establish the common denominators essential if the clinical and laboratory researches of A are to be commensurable with those of B. This can enormously increase the effectiveness of the cancer research program as a whole.

The report of this Conference consists only of this fourteen-point "manifesto," which reads as follows:

FINDINGS OF THE CONFERENCE UNANIMOUSLY ADOPTED

At the Closing Session, Monday, September 25

Animal experimentation has succeeded in identifying, at least in certain forms of cancer, two major and interacting influences. One of these is genetic, the other non-genetic. The non-genetic influences include certain chemicals, certain physical agents, endocrine imbalance and agents sometimes present in certain body fluids. In man, some non-genetic influences have been identified, and genetic influences have been strongly suggested, at least in some forms of cancer.

This evidence makes it imperative that we extend our knowledge of the interaction of these two major influences in man.

In the study of the cancer problem it is desirable to include study of all types of neoplasma, benign and malignant, as well as conditions leading to either of these.

With regard to diagnosis of any of these conditions, it is proposed to accept, for practical purposes, the diagnosis made by competent pathologists on histological sections of the tumor. When a cancer case is diagnosed on clinical grounds alone, in a family already under investigation, it should be included and designated as clinical cancer.

1. For future analysis, in cases of cancer, the following information, when available, should be stated:
   (a) The diagnosis was based on biopsy material.
   (b) The diagnosis was based on necropsy material.
   (c) The diagnosis was confirmed by the proved presence of metastases.

A complete list of the specific sites of metastases should be included, the manner of determination of the site of metastasis being specified, e.g. x-ray, histological or gross examination.

2. It is desirable to begin the program on a limited field, expanding it as trained personnel and financial support become available. Therefore, the following types of cancer are recommended as suitable for beginning the study of human cancer.

A. Breast cancer. Correlated with this study should be the following:

(1) Studies of possible hormonal influences on breast cancer with special reference to ovary, adrenal and pituitary glands.

(2) Extensive histological studies of the breast.

(3) Identical studies on women who come to autopsy who have not died of breast cancer.

(4) The collection of data concerning the possible presence of a milk influence in women.

B. Uterine cancer including fundic and cervical.

(1), (2), (3) and (4) to be observed here also, substituting uterus for breast in each case.

C. Skin. When the skin lesion is in the index cases, only histologically diagnosed cancer shall be accepted as identifying such a case.

3. The following types of cancer are recommended for inclusion in the program of study as it expands.

A. Rectal carcinoma
B. Retinoglioma
C. Malignant lymphomata

4. In the study of genetic factors in human cancer, records should be collected by trained personnel in association with selected general hospitals and cancer hospitals. The studies in different institutions should be interrelated.

5. The records should include detailed data regarding all members of the family, continued throughout life. Into these records should be incorporated names and addresses of every member of the family.

6. For each hospital there should be set up a control study group, selected so as to be entirely comparable except for the presence of cancer in the proband.

7. For each individual in the pedigree there should be collected also data regarding the AB factors, the Rh factors, the MN factors, the secretor factor, the taste deficiency factor and others for use in determining possible linkage relations.

8. The study of each individual should include a careful search for internal and external influences which may play a part in the causation of the type of cancer under consideration.

9. A central agency of national scope should be established to coordinate and guide the study.

10. A sub-committee of this agency should be formed, composed of a personnel predominantly medical but including at least a geneticist, a statistician, an endocrinologist and an epidemiologist whose breadth of training and knowledge of the various aspects of the cancer problem are sufficiently extensive to enable them to devise a standard medical history sheet for obtaining a complete medical history of the patient and a record of all such other factors as are understood at present to have a possible bearing, however remote, upon the initiation of the cancer in question. This may be expanded as experience dictates. Such a history should be arranged for coding. The information should be obtained directly from the patient and from laboratory records, not from the usual hospital history sheets, by a special worker trained for this purpose.

11. Special inquiry should be made of each patient, with or without cancer, as to his or her status as a twin, as to the type of twinning and as to the history of the other twin to date and throughout life.

12. It is recommended that the Bureau of the Census and various state departments of health be asked to cooperate in gathering information regarding the multiple birth status of: (a) persons dead of cancer or of other diseases, (b) of new births and (c) of reported living cancer and other patients.

13. The attention of the medical profession and of health authorities is called to the need for gathering reliable data regarding the incidence of various forms of cancer, by special survey or preferably by making cancer a reportable disease for use in connection with certain aspects of the studies outlined by this conference.

14. Closer cooperation is needed between those working with cancer in experimental animals and those working with human cancer in suggesting problems from one field suitable for attack in the other. Only by the use of genetically standardized strains of experimental animals can the biological effects and limits of action of many non-genetic variables be efficiently and accurately explored. The continued efforts of laboratory workers and clinical workers will be essential in relating these researches to the problem of human cancer.

These findings have been published by the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Maine. This is one of the shortest reports of a conference ever to be published, and it may be very significant.

THE ROLE OF HEREDITY IN RESPONSE TO A DRUG

As Demonstrated by the Experimental Molt of Rabbits Induced by Toxic Thallium Compounds

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THE author has shown in an earlier article[3] that thallium treatment is a convenient method for the study of the physiology of development of the wool and hair cover, as well as for general problems of physiological genetics. It is possible, for instance, to obliterate the differences between fine-wool and coarse-wool sheep with regard to the rate of change of their wool cover and the presence or absence of molting.[8,9] Fine-wool sheep never have, throughout the entire life span, a periodical natural molt, whereas in mixed-wool sheep a more or less sharply defined process of annual synchronous molting is readily noted. After the crossing of fine and mixed-wool sheep segregation occurs for the presence or absence of molting.

An experimental thallium molt can be produced in fine-wool sheep and in their naturally non-molting hybrids.[3,7,8] In addition to a general thallium molting a selective molt can be induced in mixed-wool sheep.[3,9] The genetical constitution of fine-wool sheep and of their non-molting hybrids thus prevents the natural occurrence of synchronous wool-shedding, but does not prevent the production of experimental molting.

The present paper deals with experiments on short and long-haired rabbits. Castle[1] has shown that long or angora coat in rabbits is recessive to the normal or short hair cover. The gene for normal coat length (L) has evidently mutated to the long-haired condition (l).

It is well known that hair growth in short-coated rabbits stops when the hair reaches a length of 2.5 to 3 cm. The hair length of angora rabbits is significantly greater, amounting to as much as 20 to 26 cm. or even more. Chambers[2] has studied hair growth in angora wool rabbits and has shown the existence of a difference between the duration of hair growth in short-haired and in angora rabbits. Chambers has also demonstrated that certain individual hairs in angora rabbits are non-shedding, at any rate during a two-year period.

Nevertheless, I have observed that in angora rabbits a periodical replacement of the wool cover takes place by the shedding of certain hair groups. The ability to grow hair throughout the greatest part of the year, in contrast to the sudden cessation of hair growth in short-haired rabbits, seems the most important feature of rabbits with the angora genotype. In this sense angora rabbits may be compared with fine-wool sheep and normal, short-haired rabbits with mixed-wool sheep.

The question naturally arises whether a corresponding similarity may be observed in the experimental molt which is produced by thallium, or, in other words, *whether the difference in genotype may be significant for responses to a drug.*

In order to study this question I made observations concerning the effect of thallium treatment on angora and on different races of short-haired rabbits. These experiments showed that the reactions to thallium are quite different in the two groups of rabbits. This is analogous to the difference of response in fine and mixed-wool sheep.

Producing Thallium Molt in Rabbits

I observed in 1932 that thallium compounds introduced in a single dose into the organism of a rabbit induce, during the period of wool growth, an intensive synochronous shedding of the wool. In rabbits this is a two-phase reaction: "experimental molt" in the first phase, new

wool growth in the second. We applied the term "general experimental molt" to the synchronous shedding of wool, which takes place over the whole body of the animal or over its greater part and which, in the present case, is due to the action of thallium.

We used various compounds of thallium to produce experimental molting. The preparations were administered to the animals in single doses either per os, in the form of a bolus, or as subcutaneous or intravenous injections, or by means of local cutaneous application.[11]. The specific reaction of hair as well as the experimental molt can be produced by either monovalent or trivalent thallium compounds.[10] The molt-producing doses as well as the minimal lethal doses vary for different compounds (see Table I). It is evident that the monovalent compounds are the more toxic, and that there is great variation in the toxicity of the trivalent compounds.

In the present work we have studied the influence of three groups of genes.

Thallium Response in Long-haired (Angora) Rabbits

I have shown that thallium treatment produces in each breed a typical response of the wool cover. The response of angora rabbits is as follows: Within two or three days after the introduction of thallium into the organism *a diminution of the root-strength* of the hair can be noticed in comparison with untreated animals.

The root-strength of the wool has been determined by means of pulling out several tufts of hair in different regions of the coat cover of the animal. We classify it according to a three-point system (see Table II).

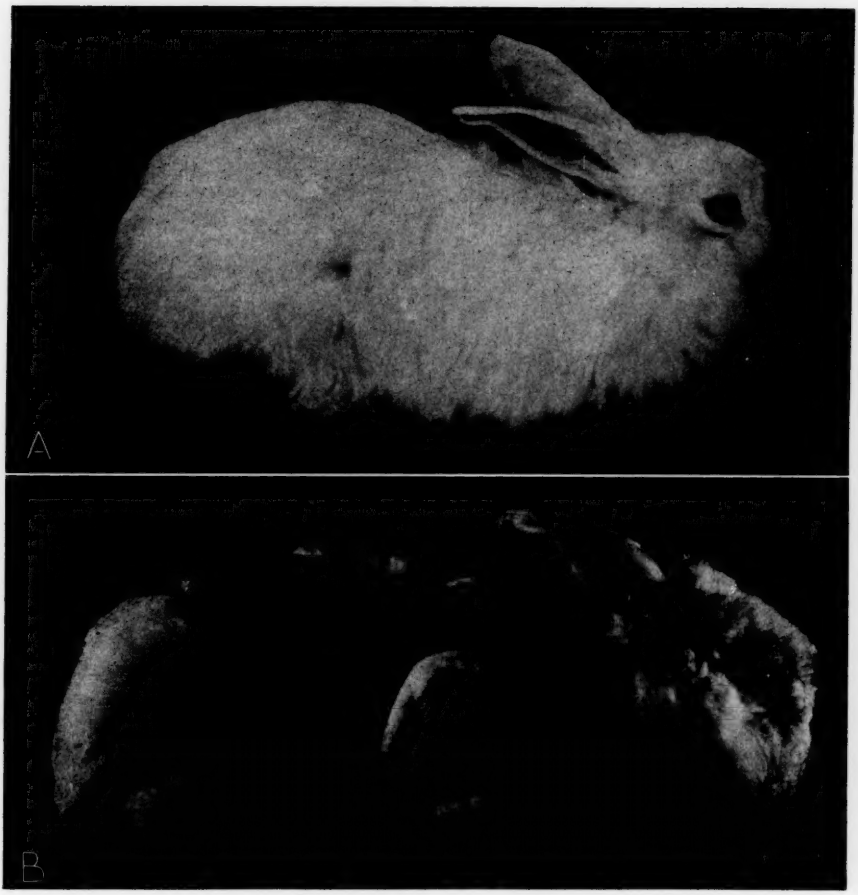
TABLE I. Molt and lethal doses for some thallium compounds (Rabbits).

Name of Compounds	Formula	Threshold for molt (mg. per kg. body wt.	Minimal lethal dose (mg. per kg. body wt.)	
Thallium acetate	CH_3COOTl	7.7-12.8	20.5-23	
Thallium alum	$Tl\ Al\ (SO_4)_2$	24.5	49	Monovalent compounds
Di-p-tolyl-thallium bromide	$p(CH_3C_6H_4)_2Tl.Br.$	41. 4	over 62	Trivalent compounds
Di-phenyl-thallium bromide	$(C_6H_5)_2Tl\ Br$	62. 1	124. 2	
Di-p-brom-phenyl-thallium bromide	$(BrC_6H_4)_2Tl.Br.$	77. 9	117	
Diethyl-thallium-phenyl-acetate		115. 2	172. 8	
Dimethyl-thallium bromide	$(CH_3)_2\ Tl.Br.$	616. 0.	924. 0.	

TABLE II. Modifications of the wool cover of angora rabbits after thallium treatment.

Phase	*Periods*			
1st degree of diminution of the root-strength of the hair	3-4	days	after treatment	
2nd " " " " " " " " " "	9-15	"	"	"
3rd " " " " " " " " " "	12-15	"	"	"
Spontaneous wool shedding	14-17	"	"	" *
Duration of absence of wool cover	10-14	"	"	" and later

*On the average, but may occur as late as 23 days after treatment.



THALLIUM MOLT IN ANGORA RABBIT

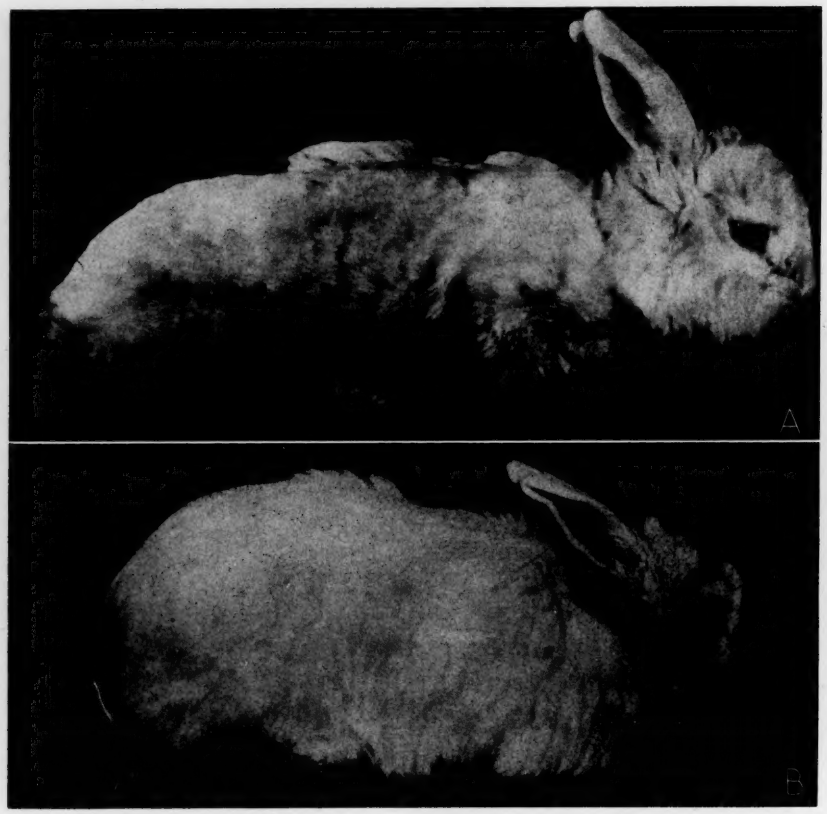
Figure 6

A shows a normal Angora rabbit prior to thallium treatment with a single dose of a thallium salt. *B* shows this same rabbit on February 1, about two weeks later. Most of the body is entirely hairless and the skin as shiny as though closely shaved. See later pictures of this animal in Figure 7.

On the 14th to 17th day after the administration of the drug the wool covering becomes detached from the body of the rabbit; hair tufts are shed and the wool cover is lost. This phenomenon was called *"spontaneous experimental molting."* As a result of such a molt the skin becomes glabrous, as if thoroughly shaved.

Subsequent to treatment with thallium, the wool cover may be removed before spontaneous shedding occurs. This is done in a fashion similar to that described earlier of sheep.[7] The bases of the staples are slightly pressed with the fingers and parts of the wool cover are successively taken off. The wool may be removed in from one to eleven minutes.

Rabbits denuded by thallium grow a new and uniform wool cover.



REPLACEMENT OF COAT

Figure 7

Two views of Angora rabbit shown in Figure 6, taken on February 18 (*A*) and March 15 (*B*). By the latter date the coat lost six weeks earlier has been completely replaced. Thallium acts only on hair that is actively growing, not on mature hair. Hence this treatment is fully effective only on the long-haired breeds, and fails to produce a complete molt in short-haired breeds of rabbits.

By means of this method we obtained between 1931 and 1941 experimental molt in more than 800 angora rabbits (see Table III). The dependence of molting and of the toxic effect upon the chemical structure of the thallium compound was described by the author in another article.[10]

Thallium Response in Short-haired Rabbits

Hereditary factors might *a priori* be supposed to influence experimental molting. Length and structure of the wool were expected to have the greatest influence upon the process in question.

As shown elsewhere,[3-5,7-8] thallium molt takes place in consequence of a temporary and synchronous disturbance of the process of hair growth. The short-haired rabbit is a kind of fur-bearing animal. The latter does not exhibit an uninterrupted hair growth throughout the whole year which is typical of fine-

"SPECTACLES" AND A NOSE-DAB

Figure 8

Almost complete shedding of an Angora rabbit, as a result of thallium treatment. Islands of unaffected fur as here shown on the head are occasionally encountered even in the long-haired rabbits. The only gene studied which was affected by thallium was that for hair length.

wool sheep or, in a less marked form, of angora rabbits.

I have compared the thallium response of long-haired (angora) and short-haired albino rabbits and have shown that a typical thallium molt may only be obtained in the former (long-haired rabbits). In angora rabbits a single administration of certain doses of thallium results at any season in a violent synchronous wool shedding over the whole body surface and this is followed by rapid replacement of the wool cover. Our short-haired habbits, on the contrary, showed a far less extreme thallium reaction which never led to complete denudation.

Among the rabbits of the albino series, we have investigated the thallium reaction in black (C), chinchilla (C^{ch}), marder (C^{m}), Himalayan (C^{h}) and albino (c). All the rabbits of this series were short-haired. No significant differences were found in the reaction of these animals to thallium. The response was in all cases that of a diffuse wool-shedding ("mosaic" molting).

TABLE III. Thallium molt in angora rabbits.

	Number of rabbits
Under the influence of monovalent thallium compounds	606
Under the influence of trivalent thallium compounds	217
Total	823

The same situation exists with regard to multiple factors determining differences in body weight. The differences between large Flemish and small Himalayan rabbits in their reaction to thallium are quite trifling.

Discussion

The occurrence of a typical thallium molt, with complete bareness of the body, is possible only in the case of growing wool. The action of thallium, inhibiting the keratinization process in the growing hair, leads to temporary and synchronous disturbances in hair growth and a thinning or rupture of the hair fibres.

The thallium reaction of animals whose wool cover is not in a growing condition never consists in a complete change of wool; *growing wool is the fundamental condition for the realization of an experimental thallium molt.* We consider the experimental induction of molting as a consequence of the temporary inhibition of the normal keratoplastic functions.[3,7]

These conclusions provide a basis for explaining the effect of thallium. Let us consider first the influence of hereditary factors. The difference in the response of long and short-haired animals is associated with a far longer period of wool growth in the case of the former. Thus experimental molting of long-haired animals can be obtained at practically any time. The long period of rest of the wool cover of short-haired animals, lasting the greater part of the year, is responsible to a considerable degree for the refractoriness of their hair cover to the action of thallium.

The long-short haired alleles are confined not only to the rabbit. If we compare reaction of different animals to thallium, we see that a typical thallium molt is obtained only in long-haired animals, namely, in fine-wool sheep, in various breeds of coarse-wool sheep, in reindeer, etc.[6] In these animals, as in angora rabbits, a thallium molt can be produced at any time and is manifested as a sudden and complete synchronous change of the whole wool cover. Short-haired animals, like rats, mice, ferrets and others, as well as short-haired rabbits never gave complete molting in consequence of a single dose of thallium. Their reaction in most cases proceeded as a diffuse replacement of individual hairs.

I did not find any significant differences in the nature of thallium molting among animals of different species and even orders if their hair cover was of the same type. Dissimilarity of the hair cover, on the other hand, produced widely varying reactions even within one species. Thus, for instance, a rodent (angora rabbits) and an ungulate (fine-wool sheep), both of which are long-haired, give highly similar responses to thallium. In contradistinction to this, the molting reactions of angora and Himalayan rabbits, which belong to the same species, differ sharply. I am inclined to extrapolate this regularity to other species of mammals.

We see, therefore, that the hereditary constitution of an animal may be a significant factor in its mode of reaction to a certain toxic element. This conclusion is illustrated also by Strong's demonstration[2] of a differential effect of methyl salycilate on tumors in two strains of inbred mice. More general attention must be given to the existence of genetically determined response differences to drugs.

Summary

1. The hereditary constitution of an animal is significant for its response to a drug or to a poison.

2. Among the genes studied in rabbits those for long and short hair are the only ones responsible for differences in the nature of the thallium molt. The presence or absence of alleles of the albino series or of genes affecting body size was of no consequence in this respect.

3. The mode of reaction in different animals seems to depend exclusively upon the type of their hair cover and the state of hair growth without being too greatly dependent upon the species or order.

4. The hereditary factors concerned

with the tissues upon which the drug in question reacts are most important for the degree or nature of response.

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◆

DOWN WITH GENETICS

Beatrice Allen

It bothers me that the carpenter's boy
Seldom plays with a wooden toy.

That the son of a shoemaker has no shoes
And the gambler's son has nothing to lose.

The sailor's son sits under a tree
While the farmer's son goes off to sea.

The doctor's son has a cold in his head;
The psychiatrist's son? He wets his bed.

The writer's son can hardly spell,
And the minister's son is headed for hell—

While the millionaire's son is filthy rich,
And the son of a bitch is a son-of-a-bitch.

Of Genes and Phenotypes

A correspondent writes:

It is urgent that the new science about which I write you shall be made known to the world because I believe it will prove to be the "missing link" to man's existence, because it will enable man not only to see his own inner self as plainly as he may reflect his outer self in a mirror, but will enable "man" to *know* "man" so that an end might be made to the great tragedies that afflict the human race today, and especially the tragedy of one group or nation condemning another or making itself superior in blood.

In my book you will positively find that many people claiming themselves superior in blood, have to varying degrees inferior blood; and you need not accept what you read—you may actually *prove* the degree of man's purity of blood, and also the degree of man's power of life; and by thus doing, you may help to eliminate the "blind guesswork" that has, up to date, brought the greatest miseries upon all races.

I do not know whether or not you believe in Astrology—you no doubt know something about it—but please, whatever you do, *do not confuse my work with Astrology*. You will find my work as compared to Astrology, as platinum against lead. Within the contents of my new book you will find one of the richest discoveries of knowledge that has ever come to man's existence since the beginning of this and perhaps previous civilizations, and a knowledge which mankind cannot go on much further without.

I do realize, gentlemen, that there are many so-called great scientific theories, especially in the medical world, and also that there are many doctrines which include for example: the doctrines of Karl Marx, Hitler, Einstein and Millikan, etc., but in no theory of science and in no doctrine (religious or scientific) will you find the answer as to why the world today is in such a "mad-house stage" and why it is hardly any more safe for any human being to exist without being condemned — which answers you will find in my work which has gone through many years of investigation and research.

My book is not just another promise to enlighten the world like so many books of science and religion created since the beginning of the present civilization. You will find in my book the *true* origin of the "diseased atmosphere" within the human race that breeds in the world today so much prejudice and hatred. And also, you will find therein an explanation as to how disease, i.e., cyclones, earthquakes, etc., originates in the Earth's atmosphere. In brief, through a careful study and analysis of my work, you will find the basic Cause of *all* evils that afflict our planet Earth.

✦

UP WITH GENETICS

ROBERT COOK

It bothers me that Beatrice Allen
Ain't fair to Genetics. She's not tellin'
That the carpenter's wife works on B29's;
That the cobbler's wife bosses assembly lines
Making tanks for the army. The gambler's son?
He's raising Hell with these toys, 'til Victory's won.

Each child has a maw as well as a paw,
Four grandparents, too, says C. Mendel's law.
Though you can't see them, they're all there too
When the genes shuffle your life for you.
They fix your wardrobe as skirts or pants,
Hair straight or curley, eyes front or askance.
No anecdote stuff: let's all have the data!
Then, Allen, we'll show you mixed pater and mater.

THE X-BIVALENT OF THE GOLDEN HAMSTER

LADLEY HUSTED, J. T. HOPKINS, JR., AND M. B. MOORE, JR.
Miller School of Biology, University of Virginia

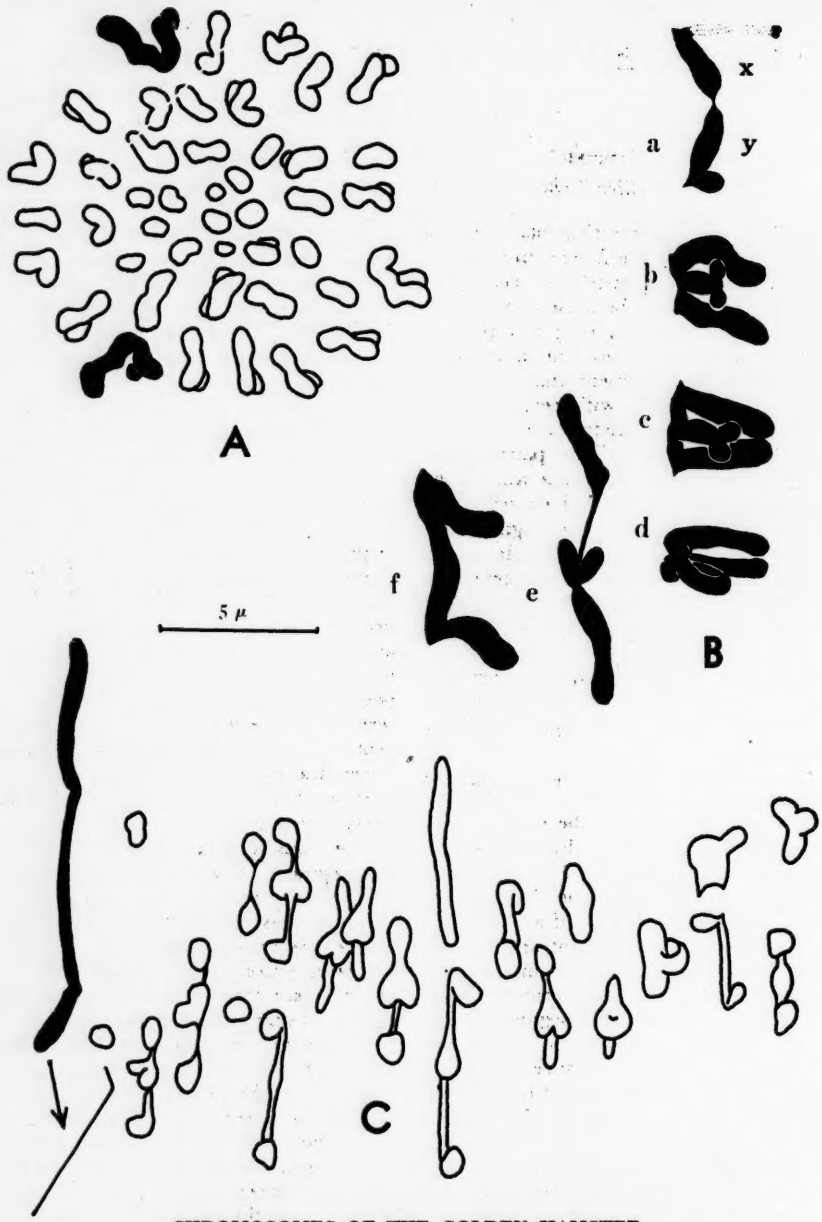
THE chromosome that has been assumed to be the *X*-chromosome of the golden hamster, *Cricetus auratus*,* is of interest because of its peculiar structure. It is made up of a pairing segment that resembles the autosomes and a differential segment that is retarded in its development with respect to the pairing segment at metaphase I in the male (Figure 9*B-a*). This pairing segment is contracted as are the autosomes and stains intensely with Feulgen. The differential segment is elongated, of smaller diameter and presumably is spiralled like a prophase chromosome. It does not stain well with Feulgen or with the usual chromosome dyes. The less intense staining reaction, the delay in contraction of the differential segment, and the behavior of the *X Y*-bivalent has been described in considerable detail by Koller.[2]

According to Koller, there is no significant difference in length of the *X*- and *Y*-chromosomes at the mitotic divisions preceding meiosis. Both have subterminal centromeres and consequently a long and short arm. The short arm of the *X*, which is made up of a small portion of the pairing segment and the entire differential segment at meiosis, "is as long . . . as the short arm of the *Y* in which the differential segment is entirely absent." At mitotic metaphase these chromosomes measure 4.5-4.8 μ in length and are the longest of the complement. At metaphase I the pairing segment of the *X* (and the entire *Y*) is 4.5-5 μ long and the differential segment 4-6 μ. The *Y*-chromosome has a subterminal centromere while the *X* is more medianly constricted. The median position of the centromere of the *X* is due to the differential segment being less contracted than the portion of the chromosome that comprises the pairing segment. Should the differential and the pairing segments be contracted to the same degree, the centromere of the *X* would presumably be subterminal or submedian.

The *X*- and *Y*-chromosomes form two types of bivalents. The symmetrical type occurs 81.6 per cent of the time as a result of the formation of chiasmata between the long arm of the *Y* and the *X*. This results in disjunctional separation or pre-reduction of the sex chromosomes. Symmetrical bivalents occur 18.4 per cent of the time as a result of the formation of chiasmata coincidentally in both arms of the *X* and *Y*. This results in equational separation at anaphase I or post-reductional segregation of the differential segment. In less than 20 per cent of the bivalents a chiasma forms between the short arm of the *Y* and the portion of the *X* proximal to the differential segment.

The unusual behavior of the differential segment of what has been termed the *X* in the male warrants some observation of this chromosome in the female, where presumably two of them occur. Three questions may be asked: Is the chromosome that bears an uncontracted, lightly staining differential segment in the male present in the female; is the portion of the chromosome which is differential in the male, if present in the female, deficient in thymonucleic acid and retarded in its development; is the same frequency and distribution of chiasmata between pairing segments of the *X* and *Y* in the male found between *X*-chromosomes in the female? We have attempted to answer these questions. We find that two large chromosomes of the

*We are indebted to Dr. C. S. Jones, Department of Zoology, University of North Carolina, for the parents from which our animals are derived.



CHROMOSOMES OF THE GOLDEN HAMSTER

Figure 9

Mitotic and meiotic chromosomes are shown—the sex chromosomes being solid black, and the autosomes in outline. All figures are ×4800. *A* shows a mitotic metaphase in an oocyte. *B* shows the sex chromosomes in meiotic metaphase; *a* in a male, showing the *X-Y* bivalent with the differential segment of the *X*; *b* shows the *X*-bivalent in the female, also in meiotic metaphase. The differential segment is lacking. The largest bivalents in four immature follicles are shown in *b-f*. *C* shows meiotic metaphase I in an immature follicle, somewhat spaced for clearness. In this figure one long arm of the *X*-chromosome is foreshortened. Its calculated length is indicated by the arrow.

size that has been designated the *X* in the male occur in the female. A less contracted, nucleic acid deficient portion is not seen in these chromosomes at mitotic or meiotic metaphase in immature follicles of the ovary. Chiasmata have not yet been observed between those portions of the large chromosomes where they might be expected to occur if distributed as in the male.

Preparation of Material

The testes of one and the ovaries of several ether anaesthetized animals 3-4 months of age were removed and submerged immediately in Sanfelice (Darlington and La Cour[1]). After 4-5 hours' fixation they were rinsed briefly in water and transferred to 70 per cent ethyl alcohol. The testes and some ovaries were stained with Feulgen in bulk prior to dehydration; others were dehydrated, cleared in chloroform, and embedded in paraffin for subsequent staining in crystal violet. Sections of the ovaries were cut (with considerable difficulty) from 25 to 32 μ in thickness.

Observations and camera lucida drawings were made with a Zeiss microscope equipped with 7-30 $\times$ oculars and a 90 $\times$ (n.a. 1.4) oil immersion objective. The drawings are all reproduced at a magnification of 4800$\times$. Sex chromosomes are represented in solid black, autosomes in outline.

Chromosome Number

In growing follicles the oöcyte nuclei frequently divide mitotically. These oöcytes, characterized by failure of meiotic pairing, show no evidence of regression, but observed binucleate and trinucleate oöcytes degenerating lead us to infer that they eventually will become atretic. Their division is especially suitable for a study of the chromosome complement. In dividing follicle-cells the chromosomes are too small and too crowded on the spindle for analysis. Koller finds the spermatogonial divisions difficult to study since the 38 somatic chromosomes are "crowded in a small equatorial plate." The oöcyte-mitosis is more favorable for study because the chromosomes at metaphase are well spread on a spindle of more than ample size. We have found two oöcytes from two different animals with nuclei at mitotic metaphase in polar view. One is a preparation stained with Feulgen and the other with crystal violet. The chromosomes lie all in one plane. In only one of these divisions is a chromosome partially obscured by another. Both divisions show 44 chromosomes (Figure 9*A*).

First and second meiotic stages are found in follicles that are by far less advanced than others containing resting nuclei. These, which we feel are prematurely undergoing meiosis, may, like the follicles containing mitotic divisions, eventually undergo atresis. We have no assurance that any of those observed would have reached maturity, but there is no evidence of cellular degeneration at the time the divisions were in progress. In no follicle, where the spindle lies uncut in the middle of a section, has it been possible to find with certainty as few as 19 bivalents, the number which has been clearly determined for the species by Koller.[2] Figure 9*C* which has been spaced somewhat for clearness is typical. Here at least 20 bivalents are oriented on the spindle. The cell may be interpreted as containing 21 bivalents, one which has not become oriented, and two univalents. All of these give a position and uniform reaction with Feulgen.

X-Chromosomes at Mitosis and Meiosis

The two largest chromosomes in the male of the golden hamster have been taken by Koller "to be the sex chromosomes because an analysis of chromosome behavior during meiosis revealed that the largest bivalent, morphologically as well as structurally, differs greatly from the others and exhibits peculiarities characterizing sex chromosomes in various species." In Figure 9*A*, two chromosomes conspicuously larger than the others of the complement can be made out. They measure approximately 4 μ in length. They have submedian centromeres and an arm ratio of 1:1.9. These

are not identical with what has been designated the *Y* in the male, for this chromosome (Figure 9*B-a*) is clearly not submedianly constricted. The *Y* chromosome figured at metaphase here has an arm ratio of 1:2.4. Those figured by Koller and suitable for measuring have an arm ratio of 1: nearly 3. It seems clear that the chromosome in the male, assumed to be the *Y* by Koller, is rightly so-called for a pair of such subterminally constricted chromosomes is not among the largest in the female complement. The *X* and *Y* are morphologically indistinguishable as to length in spermatogonial cells so it becomes apparent that the long arm of the *X* (Figure 9*A*) must be what is associated with the *Y* (Figure 9*B a*) and the short arm of the *X* must correspond in part to that portion of the *X* which is retarded in its contraction at metaphase I in the male. In young follicles the *X*-chromosomes at mitosis are uniformly stained by Feulgen and show no segment which is differentially contracted.

Six unusually well-fixed oöcytes in immature follicles at the first meiotic metaphase were found uncut in side view. The largest bivalent in each of these cells is shown in Figure 9*B b-f* and in Figure 9*C*. As in mitosis, no differential segment or portion which lags in its development with respect to the autosomes is found at metaphase I. All of the parts of these bivalents take Feulgen equally well. The more slender portion of the bivalents in Figure 9*B e* is a region attenuated as a result of tension. Such distension is seen in many meiotic divisions (see Figure 9*C*). These bivalents are undoubtedly the *X*-chromosomes for they are all easily the largest of the pairs present at metaphase. In Figure 9*C* all of the chromosomes of one oöcyte are shown. One long arm of the *X*-bivalent is foreshortened but its actual length, calculated by focusing, is indicated by the arrow.

One or two chiasmata were found in each large bivalent. These were all between short arms, the arms which in their entirety have no counterpart in the *Y*. Koller finds that a chiasma is formed between the short arm of the *Y* and the proximal region of the *X* in only 18.4 per cent of the *XY*-bivalents. We have found no chiasmata between long arms in *X*-bivalents. This suggests that with an adequate number of observations the portion of the chromosome which is prevented from crossing-over in the male may be found to form proportionally more chiasmata than that part where in the male crossing-over can occur.

Summary

Immature follicles in the ovary of the golden hamster, *Cricetus auratus*, contain chromosomes in excess of the number known for the species. Such follicles may not reach maturity. In such follicles two chromosomes which can be considered *X*-chromosomes occur. These at mitotic and the first meiotic metaphase do not show the more lightly stained, slender differential segment that is characteristic of the *X* at meiosis in the male. The *X*-chromosomes observed are associated by chiasmata in their short arms. These arms are in part made up of a portion that has no counterpart in the *Y*.

Literature Cited

1. Darlington, C. D., and L. La Cour. *The Handling of Chromosomes.* George Allen and Unwin, London. 1942.
2. Koller, P. C. *Journ. Genetics* 36:177-195. 1938.

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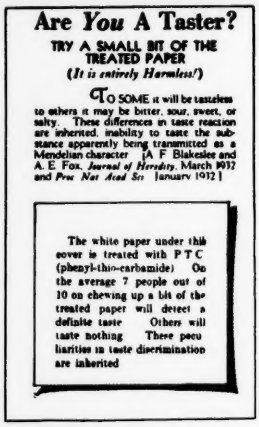
Tetraploid Bread

At a meeting of the Swedish Academy of Agriculture in the late fall the first loaf of tetraploid rye bread was served. The tetraploid rye (64 chromosomes) was developed at the Svalöf plant breeding station by Professor Arne Müntzing of Lund University. The grain weight of the tetraploid rye is 50 per cent higher than that of the diploid, but the new type is handicapped by a higher degree of sterility.—T.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